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EFFECT OF DIFFERENT DIETARY CRUDE PROTEIN LEVELS ON PERFORMANCE, N DIGESTIBILITY AND SOME BLOOD PARAMETERS IN KIVIRCIK LAMBS

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In this study, 45 weaned Kivircik male lambs with an average initial body weight [BW] of 26.23 kg were randomly assigned to five experimental groups (G_{10}, G_{12}, G_{14}, G_{16}, G_{18}) fed 10, 12, 14, 16, 18 % crude protein (CP), respectively.

It was observed that G_{16} had higher BW than the first three groups ($p<0.05$), but there were no significant differences between G_{16} and G_{18}. G_{16} had higher daily body weight gain [BWG] than other groups. During the study, when compared with first three groups, G_{16} had significantly higher BWG ($p<0.05$), but no significant difference was observed between G_{16} and G_{18}. The lowest DMI was observed in G_{10} ($p<0.05$), however, there were no differences between G_{14}, G_{16} and G_{18}. The best and the lowest feed efficiency were observed in G_{16} and G_{10}, respectively.

When the analysis results of faeces samples were compared, the lowest nitrogen (N) excretion was detected in G_{10} and G_{12}, and the highest N excretion was detected in G_{18} ($p<0.05$). However, there were no significant differences between G_{14} and G_{16}. Percentages of N digestibilities of G_{16} and G_{18} were higher than those of other groups ($p<0.05$). There were no significant differences between G_{16} and G_{18}, and between G_{10}, G_{12} and G_{14}.

The analysis results of serum samples obtained from experimental groups showed that, except for serum urea and albumin levels, there were no significant differences between the level of other metabolites. G_{10} had lowest serum albumin level ($p<0.05$), and there were no significant differences between the other groups. Serum urea levels of G_{14}, G_{16}, G_{18} were similar and higher than those of G_{10} and G_{12} ($p<0.05$). The lowest serum urea level was determined in G_{10} ($p<0.05$).

Consequently, when it was considered that feeding Kivircik lambs with higher protein level than 16 % had no advantage for performance and would be cause of economic loss, it can be said that 16 % CP was optimal.

Key words: blood parameters, crude protein level, digestibility, Kivircik lamb, performance

INTRODUCTION

Kivircik is a multipurpose lamb breed that is produced commonly in Turkey, Greece and Bulgaria for meat, milk and wool production (Aytug *et al.*, 1990). It is well known that the most important factor causing lack of yield and the restriction in lamb meat production is insufficient nutrition of animals in Turkey. Inadequate protein intake results in lower ammonia in the rumen, thus, growth of ruminal bacteria is influenced negatively. Consequently, it resulted in lower feed intake, digestibility and performance. However, the excessive protein intake caused increased feed cost and economical losses. The determination of optimum levels of dietary protein levels are also important in order to prevent environmental pollution due to emission of ammonia into the atmosphere from degradation of excreted urea, to avoid unneccessary losses of nitrogen and minimize costs of feed (Negesse *et al.,* 2001).

Many studies were carried out to determine the optimum dietary crude protein (CP) level for lambs. The NRC (1985) recommended 14.5 % CP for weaned lambs for maximum growth, but Andrews and Orskov (1970) reported that maximum weight gain occured at 17 % dietary CP. Although feeding lambs with 18 % CP diets is common practice, it was reported that lambs fed 16 and 18 % CP diet had higher body weight gains and dry matter intake than lambs fed 10, 12 and 14 % CP diet, and there were no differences between lambs fed 16 and 18 % CP (Haddad *et al.,* 2001; Titi *et al.,* 2000). They also emphasized that there were no advantages of using higher CP than 16 %.

The aim of this study was to investigate the effect of different dietary crude protein levels on performance and N digestibility for optimum growth of weaned Kivircik lambs and the effects on some blood parameters to assess biochemical changes in some metabolites such as total protein, albumin, glucose, urea, alkaline phosphatase (ALP) and lactate dehydrogenase (LDH).

MATERIALS AND METHODS

Animals and housing

Forty five male Kivircik lambs weaned at the age of 3.5 to 4 months with an average initial body weight (BW) of 26.23±0.51 kg were used in this study. The lambs were obtained from Istanbul University, Research Farm of Faculty of Veterinary Medicine and assigned randomly to five groups (G_{10}, G_{12}, G_{14}, G_{16}, G_{18}). The study was carried out in Clinical Pens of the Faculty of Veterinary Medicine, Istanbul University.

Feed formulation

Five isocaloric diets were formulated at Istanbul University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Diseases. Crude protein (CP) percentages were 10, 12, 14, 16 and 18 %, respectively. The proportions of the feedstuffs and nutrient contents of diets are shown in Table 1.

Table 1. The proportions of the feedstuffs and nutrient contents of diets

Feedstuffs (%)	Experimental groups				
	G_{10}	G_{12}	G_{14}	G_{16}	G_{18}
Pasture hay	15	15	15	15	15
Wheat bran	10	10	10	12	13
Barley grain	11.5	69.5	50	50	47.5
Soybean meal	–	2	10	15	21
Sugar beet pulp (with molasses)	60	–	11.5	4.5	–
Salt	1	1	1	1	1
Sodium bicarbonate	0.5	0.5	0.5	0.5	0.5
Limestone	1.5	1.5	1.5	1.5	1.5
Premix (vitamin-mineral)*	0.5	0.5	0.5	0.5	0.5
Calculated values					
Ham protein (%)	10.2	12.0	14.3	16.3	18.2
ME (Mcal/kg)	2.53	2.54	2.54	2.52	2.52
Contents (%)					
Dry matter (DM)	90.09	89.75	90.44	89.95	90.06
Crude protein (CP)	10.30	12.05	13.92	15.81	17.94
Crude fat	1.87	1.85	1.91	1.85	1.91
Crude fiber	5.89	5.57	5.73	5.16	4.48
Ash	12.64	5.29	6.23	6.50	7.29
Ca	0.81	0.70	0.72	0.72	0.72
P	0.45	0.65	0.61	0.67	0.72

*Ingredients of premix, kg: Vitamin A, 20,000,000 IU; vitamin D_3, 3,000,000 IU; vitamin E, 25,000 mg; Co, 200 mg; Mn, 45,000 mg; Zn, 40,000 mg; I, 300 m?g; Fe, 50,000 mg; Cu, 10,000 mg; Se, 300 mg; Mg, 100 mg

Feeding procedure

All diets were formulated to meet daily nutrient requirements of lambs (NRC, 1985). The study consisted of adaptation (15 days) and experimental (84 days) periods. During the adaptation period, lambs were fed diets consisting of a 65:35 forage to concentrate ratio, and this ratio was gradually decreased until it reached the ratio of 15:85. In the experimental period, groups (G_{10}, G_{12}, G_{14}, G_{16}, G_{18}) were fed diets containing 10, 12, 14, 16 and 18 % CP, respectively. Lambs were fed twice a day at 09:00 and 16:00 h. Water was offered *ad libitum* throughout the study. Also, all lambs were vaccinated against external and internal parasites.

Chemical analysis

All chemical analysis (dry matter, crude protein, crude fat, crude fiber, ash, Ca, P) of feedstuffs and diets, and dry matter and crude protein analysis of fecal samples collected on week 5 of study for 5 days for N digestibility, were done in Istanbul University, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Diseases according to AOAC (1984).

Serum blood samples collected on day 0, 20, 40, 60 and 80 of study were analysed for total protein, glucose, albumin, urea, alkaline phosphatase [ALP] and lactate dehydrogenase [LDH] by using Hitachi 704 Automatic Analyser in Istanbul University, Cerrahpasa Faculty of Medicine, Fikret Biyal Central Laboratory.

Calculations and statistical analysis

BWs were determined by weighing the lambs at the start of the study and at two week intervals throughout the study. Daily BWGs were calculated by using data of body weights. The amounts of feed offered and refused were recorded daily. In this study, group feeding was carried out and daily dry matter intake [DMI] was calculated by group mean two week intervals during the study. Feed efficiency was calculated by using data of weight gain and DMI. Also, CP levels of fecal samples and daily N intake were used for calculation of N digestibility.

The statistical analyses was conducted by using SPSS v10.0 for one way ANOVA (analysis of variance). Mean differences were determined by Duncan's multiple range test and means were considered significantly different at $p<0.05$.

RESULTS

Effect of dietary crude protein level on performance, N digestibility and some blood parameters are shown in Table 2, 3. Average final BWs of G_{10}, G_{12}, G_{14}, G_{16}, G_{18} were 37.98, 40.54, 41.77, 45.53, 42.43 kg, respectively. It was observed that G_{16} had higher BW than those of first three groups ($p<0.05$), but there were no significant differences between G_{16} and G_{18}. G_{16} had higher daily BWG (213.89±6.53 g/d) than those of G_{18} (191.09 g/d), G_{14} (177.20 g/d), G_{12} (177.01 g/d) and G_{10} (147.52 g/d). During the study, when compared with the first three groups, G_{16} had significantly higher average daily BWG ($p<0.05$), but no significant difference was observed between G_{16} and G_{18}. The average daily DMIs in groups G_{10} to G_{18} were 862±22.73 g, 923±22.12 g, 942± g, 984.17±g, 964.52±18.46 g, respectively, and the lowest DMI was observed in G_{10} ($p<0.05$), however, there were no differences between G_{14}, G_{16}, G_{18}. The best and the lowest feed efficiency were observed in G_{16} and G_{18}, respectively. When the analysis results of faeces samples were compared (Table 2), the lowest nitrogene (N) excretion was detected in G_{10} and G_{12}, and the highest N excretion was detected in G_{18} ($p<0.05$). However, there were no significant differences between G_{14} and G_{16}. Percentages of N digestibilities of G_{16} and G_{18} were higher than those of other groups ($p<0.05$). There were no significant differences between G_{16} and G_{18}, and between G_{10}, G_{12} and G_{14}.

The analysis results of serum samples obtained on day 0, 20, 40, 60 and 80 of study for the determination of total protein, glucose, albumin, urea, alkaline phosphatase [ALP] and lactate dehydrogenase [LDH] showed that, except for serum urea and albumin levels, there were no significant differences between the level of other metabolites (Table 3). G_{10} had lowest serum albumin level ($p<0.05$), and there were no significant differences between the other groups. Serum urea levels of G_{14}, G_{16}, G_{18} were similar and higher than those of G_{10} and G_{12} ($p<0.05$). The lowest serum urea level was determined in G_{10} ($p<0.05$).

Table 2. Effect of dietary crude protein level on performance and digestibility. (Mean±Sx, n=9)

	Experimental groups				
	G_{10}	G_{12}	G_{14}	G_{16}	G_{18}
Performance					
Initial BW (kg)	25.59±1.06	25.67±0.97	25.95±1.29	27.56±1.39	26.38±1.09
Final BW (kg)	$37.98^{c}\pm1.32$	$40.54^{bc}\pm0.91$	$41.77^{b}\pm1.23$	$45.53^{a}\pm1.01$	$42.43^{ab}\pm1.10$
BWG (g/d)	$147.52^{c}\pm10.00$	$177.01^{bc}\pm7.52$	$177.20^{bc}\pm14.81$	$213.89^{a}\pm6.53$	$191.09^{ab}\pm11.75$
DMI (g/d)	$862.00^{c}\pm22.73$	$923.00^{b}\pm22.12$	$942.00^{ab}\pm20.81$	$984.17^{a}\pm16.46$	$964.52^{ab}\pm18.46$
Feed efficiency	5.84	5.21	5.32	4.60	5.04
Digestibility					
N intake (g)	$13.34^{e}\pm0.32$	$15.13^{d}\pm0.31$	$18.85^{c}\pm0.53$	$21.79^{b}\pm0.51$	$26.23^{a}\pm0.56$
N excretion (g)	$3.78^{c}\pm0.14$	$3.92^{c}\pm0.14$	$4.95^{b}\pm0.23$	$4.87^{b}\pm0.27$	$5.83^{a}\pm0.28$
N digestib. (%)	$71.48^{b}\pm0.70$	$73.82^{b}\pm1.46$	$73.58^{b}\pm1.34$	$77.56^{a}\pm1.28$	$77.69^{a}\pm1.20$

$^{a, b, c, d, e}$ Means within a row with different superscripts differ (*P<0.05*).

Table 3. The effect of dietary crude protein levels on some blood parameters in lambs (Mean±Sx, n=9)

Blood parameters	Experimental groups				
	G_{10}	G_{12}	G_{14}	G_{16}	G_{18}
T. protein (g/dL)					
d 0	$5.51^{ab}±0.11$	$5.27^{b}±0.19$	$5.57^{ab}±0.07$	$5.66^{ab}±0.14$	$5.79^{a}±0.16$
d 20	6.26±0.12	6.08±0.12	6.27±0.17	6.39±0.20	6.12±0.12
d 40	5.79±0.20	5.68±0.14	5.84±0.17	5.98±0.12	6.06±0.13
d 60	6.07±0.12	6.28±0.07	6.28±0.07	6.32±0.11	6.23±0.15
d 80	6.28±0.18	6.25±0.12	6.56±0.11	6.61±0.11	6.61±0.10
Albumin (g/dL)					
d 0	$3.77^{ab}±0.02$	$3.72^{b}±0.02$	$3.79^{ab}±0.01$	$3.89^{ab}±0.01$	$3.76^{a}±0.02$
d 20	3.97±0.02	4.02±0.01	3.96±0.01	4.01±0.02	3.95±0.02
d 40	$3.63^{b}±0.02$	$3.88^{a}±0.01$	$3.81^{a}±0.01$	$3.90^{a}±0.02$	$3.83^{a}±0.01$
d 60	$3.90^{c}±0.02$	$4.20^{a}±0.02$	$4.05^{b}±0.01$	$4.14^{ab}±0.02$	$4.03^{b}±0.01$
d 80	$3.87^{c}±0.01$	$4.08^{b}±0.01$	$4.18^{ab}±0.02$	$4.22^{a}±0.01$	$4.17^{ab}±0.02$
Glucose (mg/dL)					
d 0	$77.60^{ab}±2.37$	$76.20^{b}±2.25$	$75.40^{b}±1.98$	$83.20^{a}±2.34$	$79.90^{ab}±1.49$
d 20	$97.40^{a}±2.22$	$90.60^{ab}±1.66$	$85.80^{b}±3.03$	$95.60^{a}±3.05$	$94.60^{a}±2.56$
d 40	80.90±2.24	80.60±3.10	75.11±3.64	71.30±4.06	77.10±3.12
d 60	$80.20^{b}±2.05$	$93.50^{a}±2.00$	$86.00^{ab}±3.22$	$88.33^{ab}±3.05$	$87.30^{ab}±3.91$
d 80	76.00±1.97	79.00±2.87	75.75±2.08	72.33±2.52	75.70±3.93

(cont. Table 3)

Blood parameters	Experimental groups				
	G_{10}	G_{12}	G_{14}	G_{16}	G_{18}
Urea (mg/dL)					
d 0	$15.90^{b}\pm1.62$	$18.80^{b}\pm2.06$	$30.70^{a}\pm2.23$	$29.30^{a}\pm1.72$	$34.00^{a}\pm2.42$
d 20	$15.40^{d}\pm1.46$	$28.10^{c}\pm2.21$	$39.40^{b}\pm2.68$	$43.80^{b}\pm3.06$	$51.50^{a}\pm1.70$
d 40	$19.40^{c}\pm1.90$	$33.50^{b}\pm1.85$	$52.55^{a}\pm3.53$	$53.20^{a}\pm4.59$	$55.10^{a}\pm2.15$
d 60	$15.70^{d}\pm0.89$	$28.10^{c}\pm2.12$	$50.25^{b}\pm4.61$	$53.00^{ab}\pm3.10$	$60.20^{a}\pm2.97$
d 80	$21.60^{c}\pm1.22$	$32.10^{b}\pm3.36$	$52.12^{a}\pm4.27$	$50.11^{a}\pm4.17$	$49.90^{a}\pm2.94$
ALP (U/dL)					
d 0	279.40±19.98	301.40±17.65	373.00±45.20	377.20±46.81	365.20±32.63
d 20	545.00±38.17	521.60±73.46	690.10±66.64	524.30±69.79	570.40±52.24
d 40	$370.20^{b}\pm39.58$	$501.80^{ab}\pm44.41$	$563.88^{a}\pm92.58$	$427.90^{ab}\pm57.04$	$487.00^{ab}\pm60.16$
d 60	$468.90^{b}\pm55.20$	$538.80^{ab}\pm52.01$	$655.25^{a}\pm92.46$	$495.55^{ab}\pm44.25$	$491.60^{ab}\pm39.01$
d 80	412.40±55.64	421.00±47.78	546.00±60.99	442.11±36.54	424.40±44.88
LDH (U/dL)					
d 0	482.60±42.86	415.70±40.70	393.80±43.81	459.50±46.79	495.80±36.43
d 20	478.90±36.33	448.50±30.34	498.10±23.35	468.50±38.78	407.60±45.44
d 40	425.10±34.72	404.50±35.72	397.00±39.45	334.40±31.31	354.20±24.51
d 60	287.50±21.61	387.90±34.51	310.12±44.25	391.55±41.42	371.70±31.84
d 80	365.90±41.40	343.10±46.03	364.25±45.60	389.11±31.20	404.40±41.08

[a, b, c, d] Means within a row with different superscripts differ (*P<0.05*).

DISCUSSION

Performance

In this study, barley grain was used as the basal energy feed. In our country, barley grain is widely used in ruminant feeding due to it being cheaper than corn. Soybean meal was used as a protein supplement in order to reach the desired protein level in the diets. In several experiments carried out in lambs in the Mediterranean Countries by U.S. Grains Council diets containing 15 % soybean meal were used, as well (Karabulut and Ak, 1990).

In this study, final BWs were 37.98, 40.54, 41.77, 45.53, 42.43 kg; average daily BWGs were 147.52, 177.01, 177.20, 213.89, 191.09 g/d; and feed efficiency ratios were 5.84, 5.21, 5.32, 4.60, 5.04, for lambs feed 10, 12, 14, 16, 18 % CP diets, respectively. Average daily BWGs in lambs fed 12, 14 and 18 % CP were similar to the results obtained by Bulgurlu and Asyali (1975), but lambs fed 16 % CP had higher BWG than that lambs fed 16.8 % CP.

Recently, in the study conducted by Titi *et al.* (2000) with 12, 14, 16 and 18 % CP diet in Awassi lambs, lambs fed 16 % CP had highest BW and daily BWG, which is agreement with our results. Also, they reported that there were no significant differences between BWGs in lamb fed 16 and 18 % CP, and these results support our findings. Similarly, Haddad *et al.* (2001) reported that lambs fed 16 and 18 % CP diet had higher BWG and DMI than lambs fed 10, 12 and 14 % CP diet, and there were no differences between lambs fed 16 and 18 % CP. They also emphasized that there were no advantages of using higher CP than 16 %. This suggestion directly agrees with our study. Yurtman *et al.* (2002) carried out a study with 15, 17.7 and 21.4 % CP diets in Turkgeldi lambs and found that lambs fed 15 % CP had higher daily BWG and DMI than those in other groups. When it was compared to our study, lambs fed 17.7 and 21.4 % CP had similar results to 16 % CP. Also, there were no significant difference between lambs fed 15, 19, 23.6 and 27.4 % CP in final BWs, daily BWGs and DMIs in the study by Nsahlai *et al.* (2002), thereby, these results can also be accepted that there are no advantages of exceeding 16 % CP for performance.

N digestibility

Findings related to N-digestibility shown that lambs fed 12, 14, 16 and 18 % CP had N-digestibility within the range reported in NRC (1985). Dabiri and Thonney (2001), who studied 13, 15 and 17 % CP diets, reported that group fed 17 % CP had higher N-digestibility than those of other groups and there were no significant difference between groups fed 13 and 15 % CP. These results agree with the relations established between lambs fed 12, 14 and 16 % CP in our study. As in our study, Haddad *et al.* (2001) also found that lambs fed 10 % CP diet had significantly lower N-digestibility than those of lambs fed 12, 14, 16 an 18 % CP. Although these researhers reported that there were no significant differences for digestibility between the last four groups, N-digestibilities in lambs fed 16 and 18 % CP in our study were very similar to their results. However, when compared, N-digestibility values in lambs fed 14 and 18 % CP and the significance of differences between these groups were similar to lambs fed 15 and 18 % CP by Beauchemin *et al.* (1995).

Blood parameters

Due to the fact that several diseases and nutritional disorders can make changes in blood parameters, the evaluation of the effects of dietary crude protein level on blood metabolites will be of benefit.

Total protein (TP), an important factor for blood viscosity, acid-base balance and supplying necessary enzymes, can vary between species. The range value for TP in sheep is between 5.5-7.5 g/dL (MVM, 1991). In this study, there were no significant differences in TP levels for lambs fed 10, 12, 14, 16, 18 % CP during all periods. These results showed that there were no effects of dietary CP levels on serum TP levels, and they are similar to the findings of Shalu *et al.* (1993), Hatfield *et al.* (1998) and Ivey *et al.* (2000).

Urea is an important metabolite synthesized from ammonia in the liver during protein metabolism. Despite some researchers suggested that there was a correlation between plasma urea level and dietary protein level in sheep (Lindberg and Jacobbsson, 1990; Waghorn *et al.,* 1990), Kronfeld *et al.* (1982) suggested the opposite. The urea levels of lambs in this study were compared to normal levels (reported as 20-30 mg/dL) (Bilal, 2004), it was observed that lambs fed 10 and 12 % CP had normal levels, but lambs fed 14, 16 and 18 % CP had higher than normal range values. The changes in serum urea levels by increasing dietary portein level are agreement with the results of prior studies (Oldham et al, 1979; Bunting *et al.,* 1987; Shalu *et al.,* 1993; Katunguka, 1997; Hatfield *et al,* 1998; Dabiri and Thonney, 2001; Yurtman *et al.,* 2002).

Many researchers reported that the differences in diet composition could affect blood glucose levels (Judson *et al.*, 1968; Shetaewi *et al.*, 1991; Quingley *et al.*, 1992). It was reported that normal blood glucose level in sheep was between 44.0-81.2 mg/dL. In this study, serum glucose levels were in normal range and there were no significant difference. This finding was in agreement with those obtained by Shalu *et al.* (1992, 1993), Katunguka (1997) and Hatfield *et al.* (1998).

The synthesis of albumin in the liver, which is an important metabolite for plasma oncotic pressure, can decrease in the case of malnutrition, hepatic deseases, protein deficiency, starvation and malignancy (Turgut, 2000). It was reported that there was a high correlation between serum albumin, blood urea-nitrogen and protein intake (Thomas *et al.,* 1988). In this study, lambs fed 10 % CP had lowest serum albumin level ($P<0.05$) and there were no significant differences between lambs fed 12, 14, 16 and 18 % CP. The differences for albumin levels in lambs fed 10 and 18 % CP were similar to those of lambs fed 8.1 and 17.6 % CP by Katunguka, (1997). In contrast, Oldham *et al.* (1979) reported that there was no significant difference for albumin levels between heifers fed 10.7 and 22.3 % CP diets, and probably this result is due to the species difference.

Also, there were no differences between groups for ALP and LDH levels, and this finding is agreement with Hatfield *et al.* (1998).

CONCLUSION

There were no significant differences between lambs fed 16 and 18 % CP for final BW, average daily BWG, blood parameters and N-digestibility. Lambs fed 10, 12 and 14 % CP had significantly lower performace and N-digestibility than other groups. Lambs fed 16 and 18 % CP had statistically similar results for final BW and average daily BWG. Feeding with 16 % CP diet resulted in better feed efficiency than 18 % CP diet. Also, bedding problems were observed in lambs fed 18 % CP diet due to increased urination. This event was considered to be an important problem for animal health and environment. It can be concluded that optimum dietary CP level for Kinirick lambs is 16 %, because of feeding lambs with higher protein levels than 16 % had no evident advantages for performance and production.

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EFEKTI RAZLIČITIH KONCENTRACIJA SIROVIH PROTEINA NA PROIZVODNE PARAMETRE, SVARLJIVOST AZOTA I NEKE PARAMETRE KRVNE SLIKE KOD JAGANJACA RASE KIVIRCIK

KESER O i BILAL T

SADRŽAJ

U ova ispitivanja je bilo uključeno 45 muške jagnjadi rase Kivircik, prosečne telesne mase od 26,23 kg koja su bila metodom slučajnog izbora podeljena u pet jednakih grupa: G_{10}, G_{12}, G_{14} , G_{16} i G_{18}. Ova jagnjad su bila hranjena obrocima koji su sadržavali 10, 12, 14,16 i 18% sirovih proteina, respektivno.

Na kraju ogleda, jaganjci iz grupe G_{16} imali su veću telesnu masu u odnosu na prve tri grupe ($p<0,05$) ali nije bilo razlika između ove i G_{18} grupe. Jaganjci iz grupe G_{16} imali su i veći dnevni prirast u odnosu na sve ostale grupe. Ovaj fenomen je zapažen i tokom ogleda ili između grupa G_{16} i G_{18} razlike nisu bile statistički značajne. Najniži DMI je registrovan u grupi G_{10} ali nije bilo značajnih razlika između grupa. Konverzija hrane je bila najmanja u grupi G_{16} a najveća u grupi G_{10}.

Analizom uzoraka fecesa je utvrđeno da je najniži stepen ekskrecije azota u grupama G_{10} i G_{12} a najveći u grupi G_{18} ($p<0,05$). Između grupa G_{14} i G_{16} nije bilo ststistički značajnih razlika u srednjim vrednostima za ovaj parametar. Procenat svarljivosti azota je bio veći u grupama G_{16} i G_{18} u odnosu na druge grupe ($p<0,05$), ali između ovih grupa nije bilo statistički značajnih razlika, kao ni između grupa G_{10}, G_{12} i G_{14}.

Analizom uzoraka seruma oglednih životainja utvrđene su razlike samo u koncentracijama uree i ukupnih albumina. Jagnjad iz grupe G_{10} imala je najnižu koncentraciju albumina ($p<0,05$) ali nije bilo značajnih razlika između drugih oglednih grupa. Koncentracija uree je bila veća (i slična) u grupama G_{14}, G_{16} i G_{18} u odnosu na grupe G_{10} i G_{12}. Najniža koncentracija uree je registrovana u grupi G_{10} ($p<0,05$).

Dobijeni rezultati ukazuju da je ishrana jagnjadi ove rase i ovog uzrasta, obrokom koji sadrži 16% sirovih proteina optimalna i da dalje povećanje udela sirovih proteina u obroku nema ekonomsku opravdanost.